Rectified circulation of the Arabian Sea and its Seasonal Internal Wave Field

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LONG-TERM GOALS

Our long-term goals are to exploit multiple datasets, collected as part of NASCar, together with satellite data and simulations, to characterize and quantify, for the first time, the residual circulation and internal wave field of the Arabian Sea as well as its connectivity with adjacent basins.

OBJECTIVES

(1) To characterize and quantify residual circulations and connectivity of the monsoonal current systems in the Arabian Sea, in particular the exchanges between the Somali Current, the interior of the basin, the tropical gyre south of the equator, and the Bay of Bengal.

(2) To map seasonal internal wave propagation, dissipation, and mixing in the Arabian Sea and investigate the relationship between seasonal changes in the internal wave field and variability in the winds, stratification, and the eddy field.

APPROACH

Due to the extreme seasonal variability of the Arabian Sea, Eulerian studies lead to the appearance of connectivity between current systems which do not exist in reality (Beal et al., 2013). Hence, we will exploit Lagrangian analyses.

For our first objective we will analyze surface drifter trajectories, conduct 2-D particle tracking experiments using gridded drifter and altimeter products, and conduct 3-D experiments using the two regional models (data assimilative and fully coupled) developed for NASCar. These analyses will be conducted in collaboration with NASCar PIs Centurioni (drifters) and Jensen (models). For particle tracking we will use the freely available Connectivity Modeling System (CMS, Paris et al, 2013).

For our second objective we will quantify surface velocity variance in the diurnal and semi-diurnal tidal bands and in the inertial band (which varies as a function of latitude) using rotary spectral analysis (Elipot and Lumpkin, 2008). Our primary dataset will be new hourly surface drifter velocities, developed by us in collaboration with Lumpkin and Perez at NOAA's Global Drifter Program, as well as those to be released by PI Centurioni during NASCar. Wind stress information is readily available

through a number of reanalyses products, such as ERA-Interim and NCEP. Stratification will be estimated using historical hydrographic data and profiling float data, in collaboration with PI Jayne.

WORK COMPLETED

Elipot has produced the new drifter product at hourly resolution, in collaboration with Lumpkin and Perez and NOAA's Global Drifter Program. This product is essential to our analysis of internal waves.

RESULTS

Funding arrived this month (September 2015) and we have few results thus far. Preliminary results from the new drifter product show that tidal variance in the Arabian Sea is an order of magnitude larger than predicted from a barotropic tidal model.

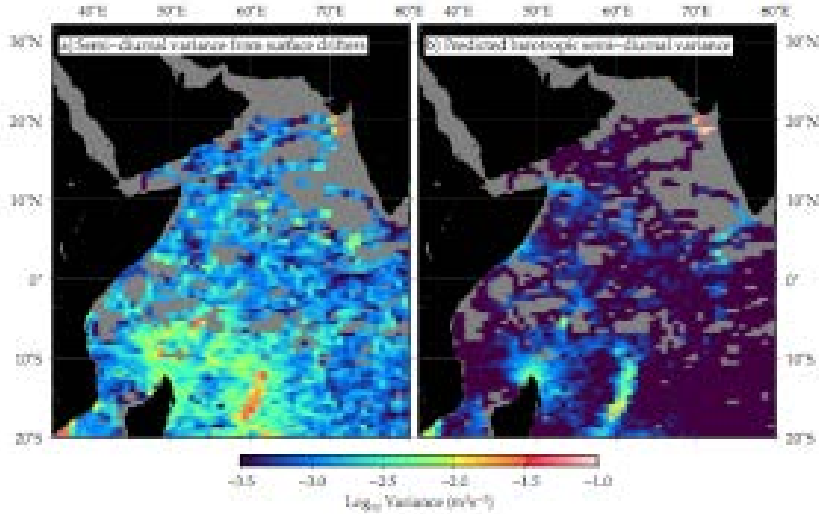

Figure 1: Semi-diurnal velocity variance from drifter trajectories (left), and predicted semi-diurnal barotropic tidal variance from altimeter (right).

IMPACT/APPLICATIONS

There is no steady circulation in the Arabian Sea and this has profound impacts on western boundary dynamics and cross-equatorial flow, on the connectivity of currents and dispersion of properties, and potentially on the internal wave field. These are important drivers of stratification and sea surface temperature (SST) changes across the Arabian Sea. Hence, our research has implications for the predictability of climate and monsoon rainfall across the region.

RELATED PROJECTS

NASCar projects of Centurioni, Jensen, and Jayne.

REFERENCES

Beal, L. M., V. Hormann, R. Lumpkin, & G. R. Foltz (2013) The response of the surface circulation of the Arabian Sea to monsoonal forcing. J. Phys. Oceanogr., 43, 2008-2022, doi: 10.1175/JPO-D-13- 033.1.

Elipot, S., & Lumpkin, R. (2008). Spectral description of oceanic near‐ surface variability. Geophys. Res. Lett., 35(5).

Paris, C. B., Helgers, J., Van Sebille, E., & Srinivasan, A. (2013). Connectivity Modeling System: A probabilistic modeling tool for the multi-scale tracking of biotic and abiotic variability in the ocean. Environmental Modelling & Software, 42, 47-54.